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TECHNICAL MEMORANDUM **CH2MHILL**

# Use of KB-1™ to Treat Bunker Hill Mine Water

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## Introduction

This technical memorandum provides a review of the use of the KB-1™ chemical sold by the Klean Earth Environmental Company (KEECO) to treat Bunker Hill mine water. Use of KB-1™ was originally discussed in the July 28, 1999 AMD Treatment Presumptive Remedy Technical Memorandum, in which the following issues were raised:

- Ability to meet the draft TMDL based treatment goals
- KB-1™ is a proprietary chemical, which likely means the chemical will be more costly than lime due to the sole-source supplier and reduced competitiveness
- Potential to generate a greater mass of sludge than lime neutralization due to silicates or other insoluble proprietary components
- No clear potential advantages over more traditional conventional treatment processes, such as lime high density sludge, sulfide precipitation, iron co-precipitation, or ion exchange

Each of these issues is discussed in more detail below.

## Ability to Meet Draft TMDL Treatment Goals

Lead, cadmium, and zinc are the primary contaminants of concern. The draft TMDL treatment goals are shown in Table 1. Table 2 summarizes information submitted by KEECO and the reported treatment levels achieved for cadmium, lead, and zinc using KB-1™.

Based on the reported treatment results summarized in Table 2, it is still unclear if the KEECO KB-1™ treatment process is capable of meeting the Draft TMDL based treatment goals for cadmium, lead, and zinc shown in Table 1.

**TABLE 1**
Draft TMDL Waste Load Allocations (WLA)
*Limits are Based on Total Recoverable Metal*

| Parameter | 7Q10[b] River Flow µg/L[a] | 7Q10[b] River Flow lb/day | 10% River Flow µg/L[a] | 10% River Flow Lb/day | 50% River Flow µg/L[a] | 50% River Flow lb/day | 90% River Flow µg/L[a] | 90% River Flow lb/day | River Water Quality Criterion µg/L |
|---|---|---|---|---|---|---|---|---|---|
| Total Zinc | 11.5 | 0.309 | 13.7 | 0.370 | 52 | 1.40 | 183 | 4.92 | 32 |
| Total Lead | 0.48 | 0.0130 | 0.58 | 0.0156 | 2.18 | 0.0589 | 7.7 | 0.207 | 0.54 |
| Total Cadmium | 0.157 | 0.00423 | 0.188 | 0.00506 | 0.711 | 0.0192 | 2.5 | 0.0674 | 0.38 |

[a] Concentration limits are based on a historical CTP effluent flow rate of 2,240 gpm. The mass-based limits are based on river flow and not effluent flow; at a given river flow condition, the allowable effluent concentration will be higher if effluent flow is decreased; and lower if the effluent flow is increased.

[b] The 7Q10 river flow is the lowest 7-day average daily river flow that occurs with a 10 year return period. This flow is the characteristic flow used for water quality compliance for chronic aquatic health criteria, as required by the National Toxics Rule.

**TABLE 2**
KEECO Information Reviewed and reported Cadmium, Lead, and Zinc treatment results

| Title | Author and Date | Information Type | KB-1™ Reported Treatment Levels Achieved |
|---|---|---|---|
| Report on the Initial Field Test Water Quality of Acid Mine Water Treated with KEECO Product KB-1 at the Bunker Hill Mine in Kellogg, Idaho | KEECO, September 1997 | Field Test Report, Pilot Trial | Lab Study (Lowest Reported Levels Achieved):<br>Cd: No data<br>Pb: 2.5 µg/L<br>Zn: < 0.8 µg/L<br><br>Field Study (Lowest Reported Levels Achieved):<br>Cd: No data<br>Pb: 14.8 µg/L<br>Zn: 140.9 µg/L |
| AMD Treatment Demonstration, Wheal Jane Tin Mine, Cornwall, U.K., performed for the U.K. Environment Agency | KEECO, 1996 | Report, Pilot Trial | Cd: <1 µg/L<br>Pb: No data<br>Zn: < 10 µg/L |
| Klean Earth Environment Company Statement of Qualifications | KEECO, February 1999 | Statement of Qualifications | Three projects reported:<br><br>California Mine Project:<br>No specific concentrations reported, reported reductions of 99.9%<br><br>Bunker Hill Mine:<br>Cd: <1 µg/L<br>Pb: 4 µg/L |

**TABLE 2**
KEECO Information Reviewed and reported Cadmium, Lead, and Zinc treatment results

| Title | Author and Date | Information Type | KB-1™ Reported Treatment Levels Achieved |
|---|---|---|---|
| | | | Zn: < 1 µg/L<br><br>Wheal Jane Tin Mine:<br>Cd: <1 µg/L<br>Pb: 5 µg/L<br>Zn: 123 µg/L |
| New Technology Fact Sheet | CH2M HILL, August 26, 1997 | Fact Sheet | No specific concentrations reported, reported effectiveness of 95 to 99% for most metals |
| KEECO's Innovative Environmental Technology Approved for Application to Federal Military Sites | KEECO, June 25, 1999 | Press Release | No concentrations or percent removals reported |
| Untitled Project Summary Sheet:<br>Source: Acid Mine Drainage<br>Location: Kellogg, Idaho<br>Client: The New Bunker Hill Mining Company | KEECO, Undated | Project Summary Sheet, Pilot – Scale Trial | Cd: <DL, DL not reported<br>Pb: 4 µg/L<br>Zn: < 1 DL, DL not reported |
| Untitled Project Summary Sheet:<br>Source: Acid Mine Drainage<br>Location: Central Nevada<br>Client: Confidential Mining Client | KEECO, Undated | Project Summary Sheet, Bench-Scale Trial | Acid Steam 1:<br>Cd: <2 µg/L<br>Pb: No data<br>Zn: <2 µg/L<br><br>Acid Steam 2:<br>Cd: 19 µg/L<br>Pb: No data<br>Zn: <2 µg/L |
| Untitled Project Summary Sheet:<br>Source: Acid Mine Drainage<br>Location: Butte, Montana<br>Client: Berkley Pit | KEECO, Undated | Project Summary Sheet, Bench-Scale Trial | Cd: <DL, DL not reported<br>Pb: <DL, DL not reported<br>Zn: <DL, DL not reported |
| Untitled Project Summary Sheet:<br>Source: Acid Mine Drainage<br>Location: British Columbia, Canada<br>Client: Gormeley Process Engineering for Britannia Mine | KEECO, Undated | Project Summary Sheet, Bench-Scale Trial | Cd: <2 µg/L<br>Pb: No data<br>Zn: <10 µg/L |
| Untitled Project Summary Sheet:<br>Source: Collection Pond Waters<br>Location: Nevada<br>Client: Confidential Mining Client | KEECO, Undated | Project Summary Sheet, Bench-Scale Trial | Cd: <DL, DL not reported<br>Pb: <DL, DL not reported<br>Zn: <DL, DL not reported |
| Untitled Project Summary Sheet:<br>Source: Acid Mine Drainage<br>Location: Cornwall, U.K.<br>Client: Wheal Jane Mine | KEECO, Undated | Project Summary Sheet, Pilot-Scale Trial | Cd: <1 µg/L<br>Pb: No data<br>Zn: <123 µg/L |

DL = Detection Limit

## Proprietariness of KB-1™

Because KB-1™ is a proprietary chemical, it is likely that it will be more costly than lime due to the reduced competitiveness created by a single supplier. Reliance on a single supplier also increases the potential that chemical supply interruptions will shut down the treatment plant, since other suppliers are unavailable.

## Potential to Generate More Sludge Mass

It appears that KB-1™ contains silica ingredients which will likely result in more sludge mass being created compared to lime. Although KEECO will not disclose the chemical makeup, KEECO states that the precipitated heavy metals are completely encapsulated in a microscopic matrix consisting primarily of silica (KEECO Statement of Qualifications). It is reported that these silicates have the benefit of rendering the sludge capable of passing TCLP testing. However, the existing lime neutralized sludge already passes TCLP testing, so this would not be a benefit over lime.

## No Clear Advantages Over More Traditional Processes

Based on the reviewed information, there are still no clear advantages of KB-1™ over more traditional treatment processes, such as lime high density sludge, sulfide precipitation, iron co-precipitation, or ion exchange. The technology is still relatively new, and has less full-scale application experience.

## Summary

Because of the aforementioned reasons, it is recommended that KB-1™ not be considered further for treating Bunker Hill mine water. KB -1™ has no clear advantages over the more traditional treatment processes being considered.